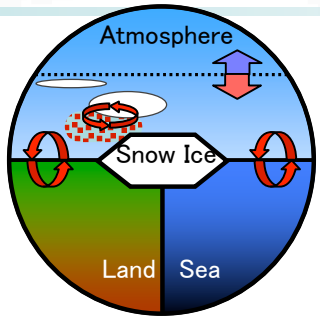
JAXA Program Status

Riko Oki, Masahiro Kojima, and Kenji Nakamura
Japan Aerospace Exploration Agency
GPM GV Workshop at Busios, Brazil
4 March 2008

JAXA's Earth Observation Satellite Program for Climate Change and Water Cycle

Collaboration with climate model research organization



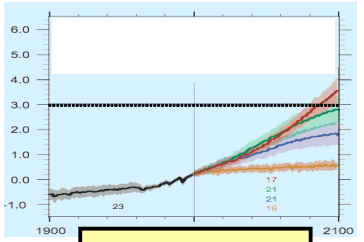
Accuracy Improvement

Climate model

Climate Model Prediction

- Surface temperature
- Sea Water level
- Area covered by snow & ice
- Precipitation distribution

Application of the Results



Policy Making

Combined use of satellite data & ground observation

Input

Comparison

JAXA's contribution

Earth Observation Program

GOSAT (TANSO)

Global Distribution of CO2

Climate Change

Exhaust of CO2 by human activity

CO2 concentration change in the atmosphere

Heating

Global Warming

Water Cycle Variation

Water Vapor

Sea

Absorption

Cooling

Aerosol ⇔Cloud

Vegetation

Precipitation

GCOM-C1 (SGLI)

EarthCARE (CPR)

GCOM-W1 (AMSR2)

GPM (DPR)

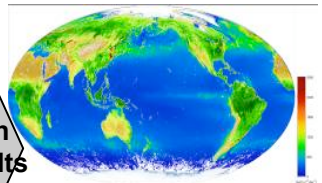
Horizontal Distribution of Cloud & Aerosol Vegetation over land & sea

Vertical Distribution of Cloud & Aerosol

Horizontal Distribution of Water Cycle

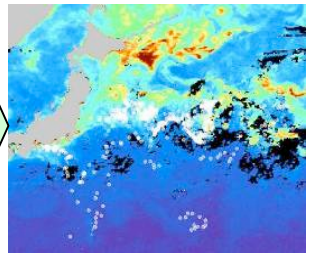
3D Distribution of Precipitation

Application of the Results



Monitoring & Analysis of the Global Change

Data Use



Operational Use

Objectives of the JAXA's GPM/DPR Project

Objectives of GPM/DPR project

- Highly accurate & frequent global precipitation observation for climate and water cycle change
- Near real-time global precipitation map distribution Data utilization method development
- Development and demonstration of the improved precipitation derivation method of the MWRs using DPR data
- Application demonstration for operational use, such as flood prediction, numerical weather forecast, prevention of the damage from a storm and flood
- Demonstration of the technology of the DPR

Mission Requirements of GPM/DPR system

- ±10% accuracy achievement of the latitude distribution of the monthly averaged global precipitation
- Continuous observation of the precipitation with the sensitivity of 0.2mm/h from the non sun-synchronous orbit (inclination: 65 degrees)
- Daily averaged rainfall estimation accuracy of better than ±40% for the basin area larger than 20000m2
- Near real-time distribution of the GMI and other constellation satellite data, and the global precipitation map product

Mission requirements of the GPM total system realized by international cooperation

- Global precipitation observation including solid precipitation
- Highly accurate observation
  - ・Observation of the vertical structure of precipitation
  - ・Identification of solid precipitation
  - ・Observation of the weak rain and snowfall
  - ・Estimation of DSD
  - ・Improvement of the precipitation estimation accuracy of MWRs using DPR data
- Highly frequent observation
  - ・Diurnal cycle observation
  - ・Highly frequent observation, and near real-time data processing and distribution to users

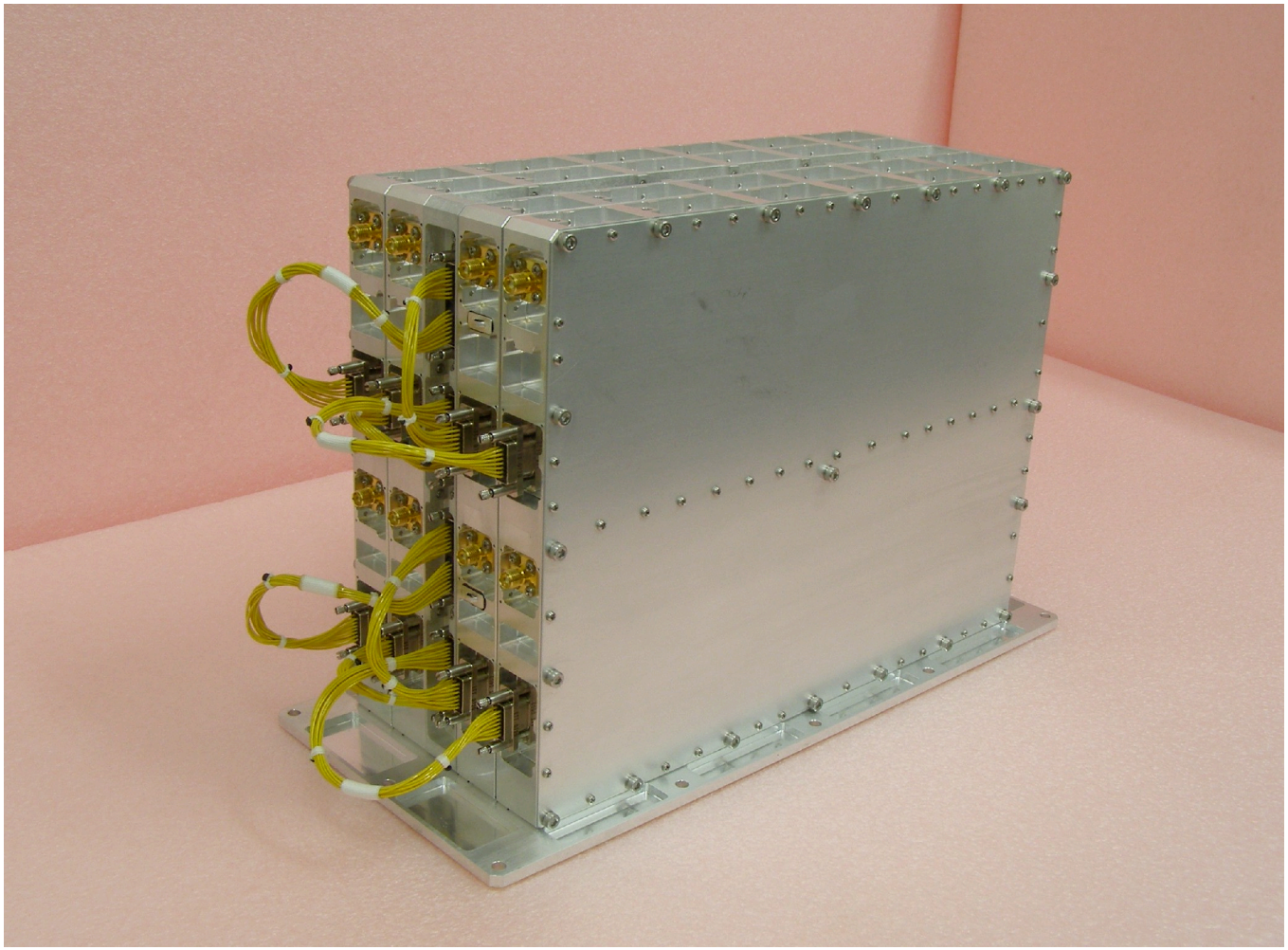
Progress and Status – Program Level -

- Review results by the government
  - Japanese Space Activity Committee (SAC) reviewed moving of the GPM/DPR project from phase B to phase C/D in July-August, and it was approved.
  - Council for Science and Technology Policy (CSTP) reviewed the GPM/DPR project in Sep. – Oct., and it was concluded that GPM/DPR is the very important project in the long range view.
- Letter exchange between Dr.Stern and Dr.Horikawa to re-confirm GPM core observatory launch in the summer of 2013.

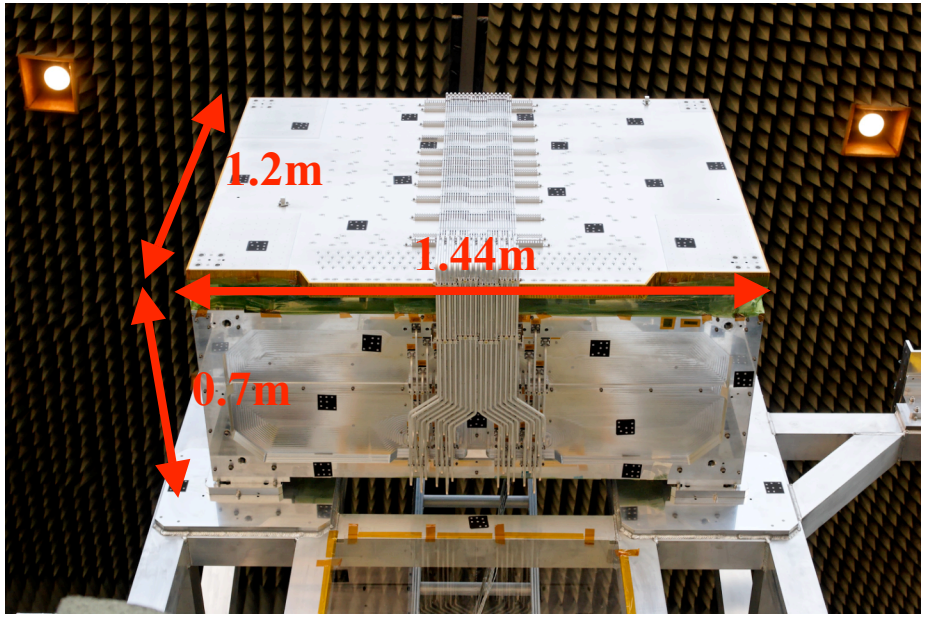
Progress and Status – DPR Project -

- Preliminary Design Review (PDR)
  - Baseline document review : Completed in Nov. 2006
  - Components PDR : Completed in Nov.- Dec. 2006
  - Structure and Thermal subsystem PDR : Completed in July, 2007
  - Reliability PDR : Completed in Sep. 2007
  - Interface PDR : Completed in Sep.2007
  - Phase 1 Safety Review : Completed in Oct.2007
  - DPR system PDR : Planned in Feb. 2008
  - JAXA final PDR : Planned in 2008
- KuPR and KaPR system configuration changed in order to eliminate single failure point as much as possible
- Engineering Model (EM)
  - KaPR and KaPR EM fabrication and test on-going
- Hybrid IC (HIC) manufacturing for the flight T/R module will start from January, 2008

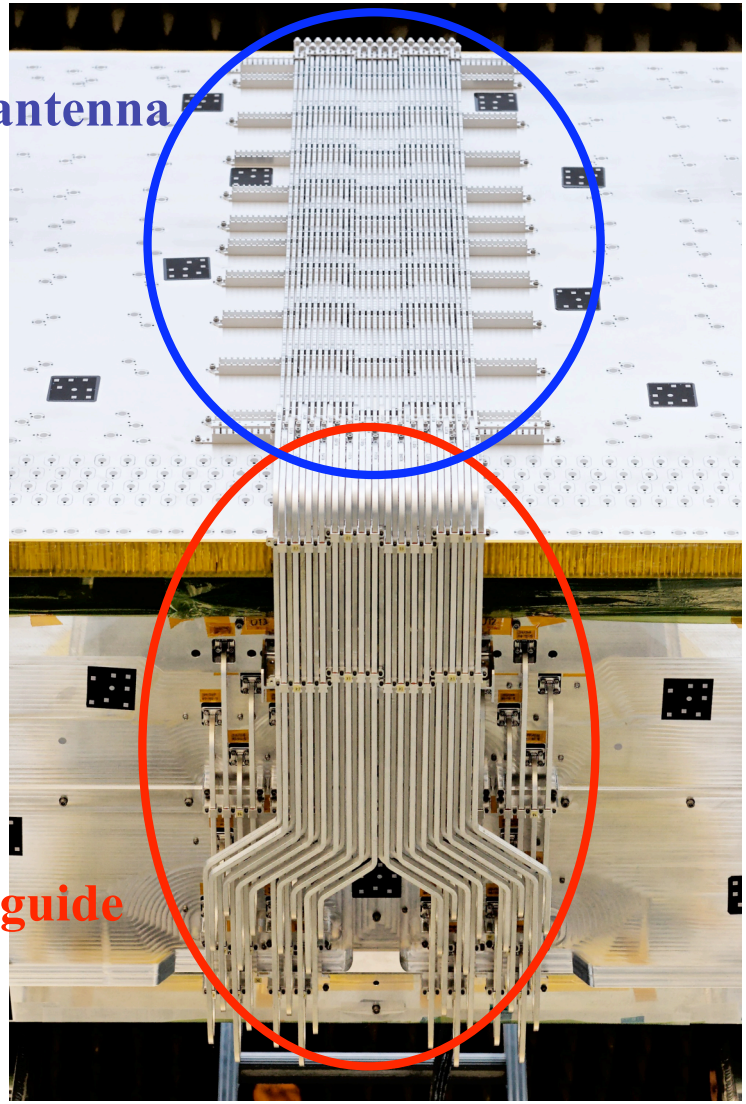
KuPR T/R unit EM（Before black painting）



KaPR EM（Fabrication & test by NICT）

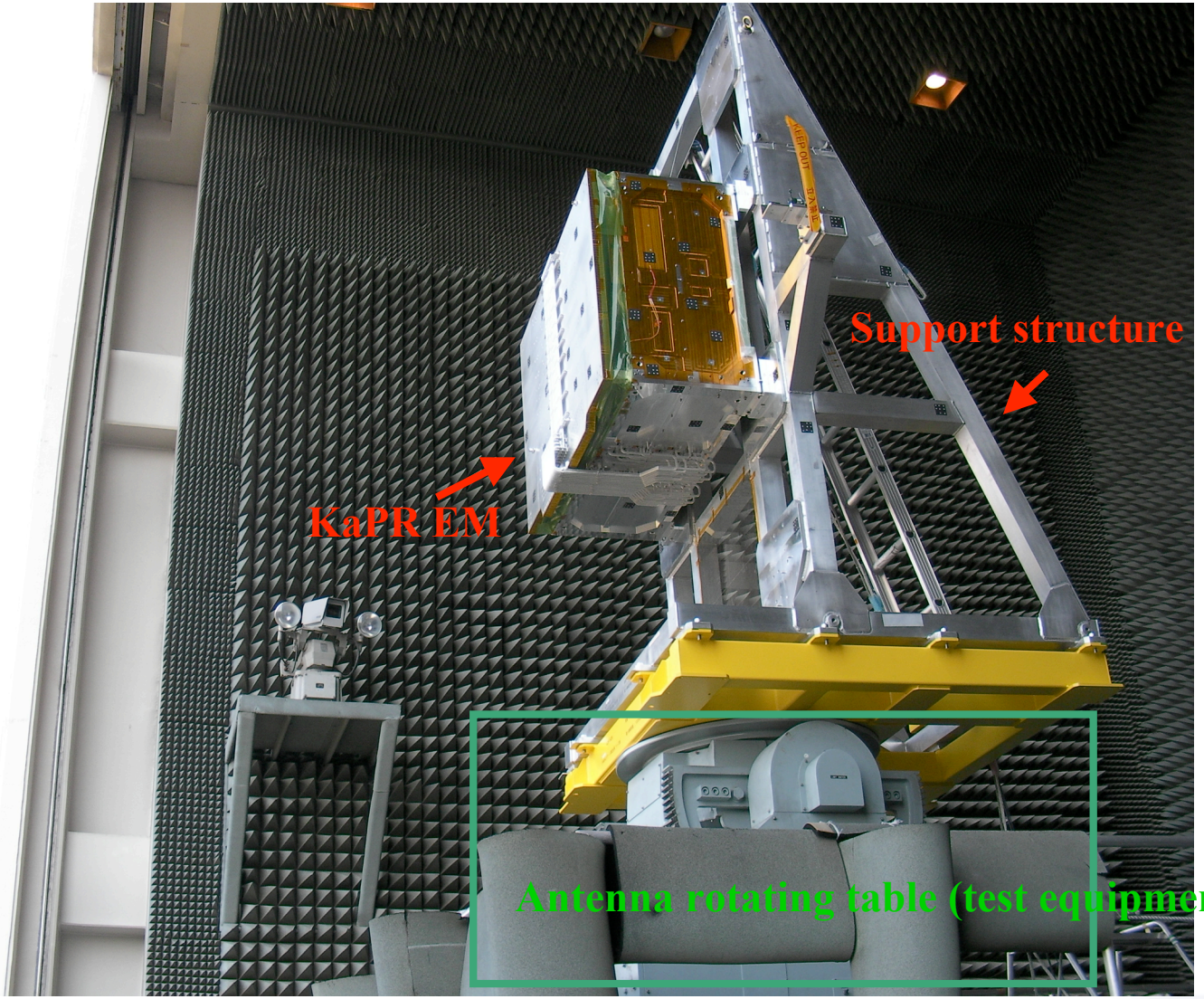


Waveguide slot-array antenna

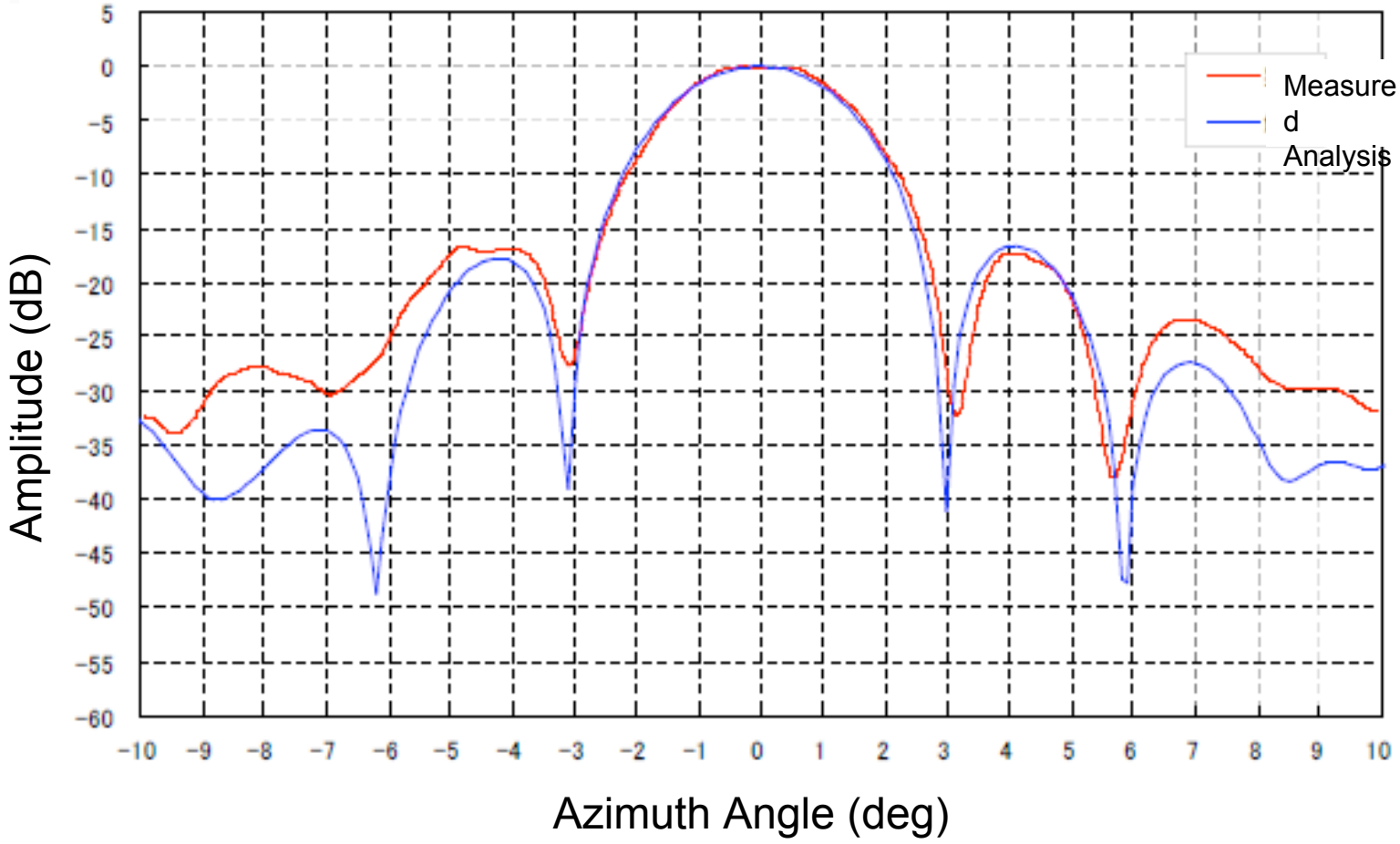


waveguide

View of the KaPR EM test at TKSC(performed by NICT)



Example of antenna pattern of KaPR EM (TX)

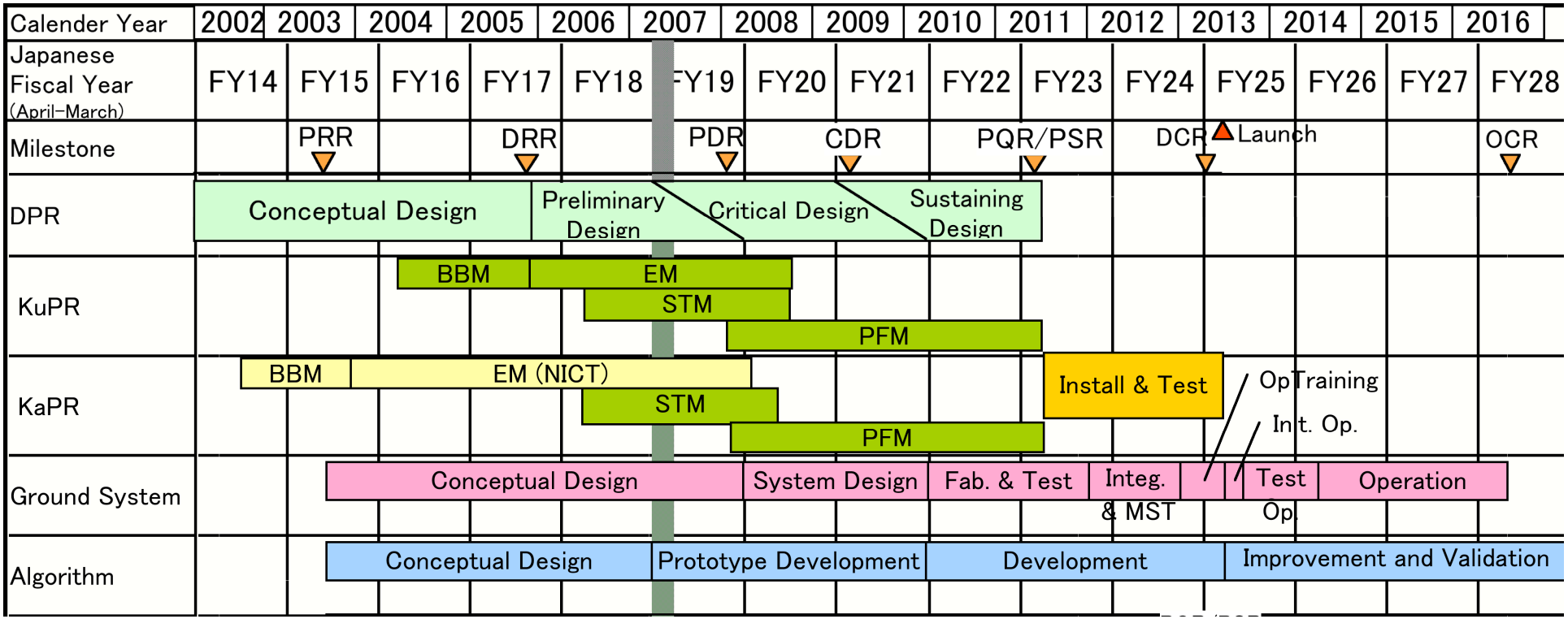


Measured value is almost equal to analysis value in the main lobe.

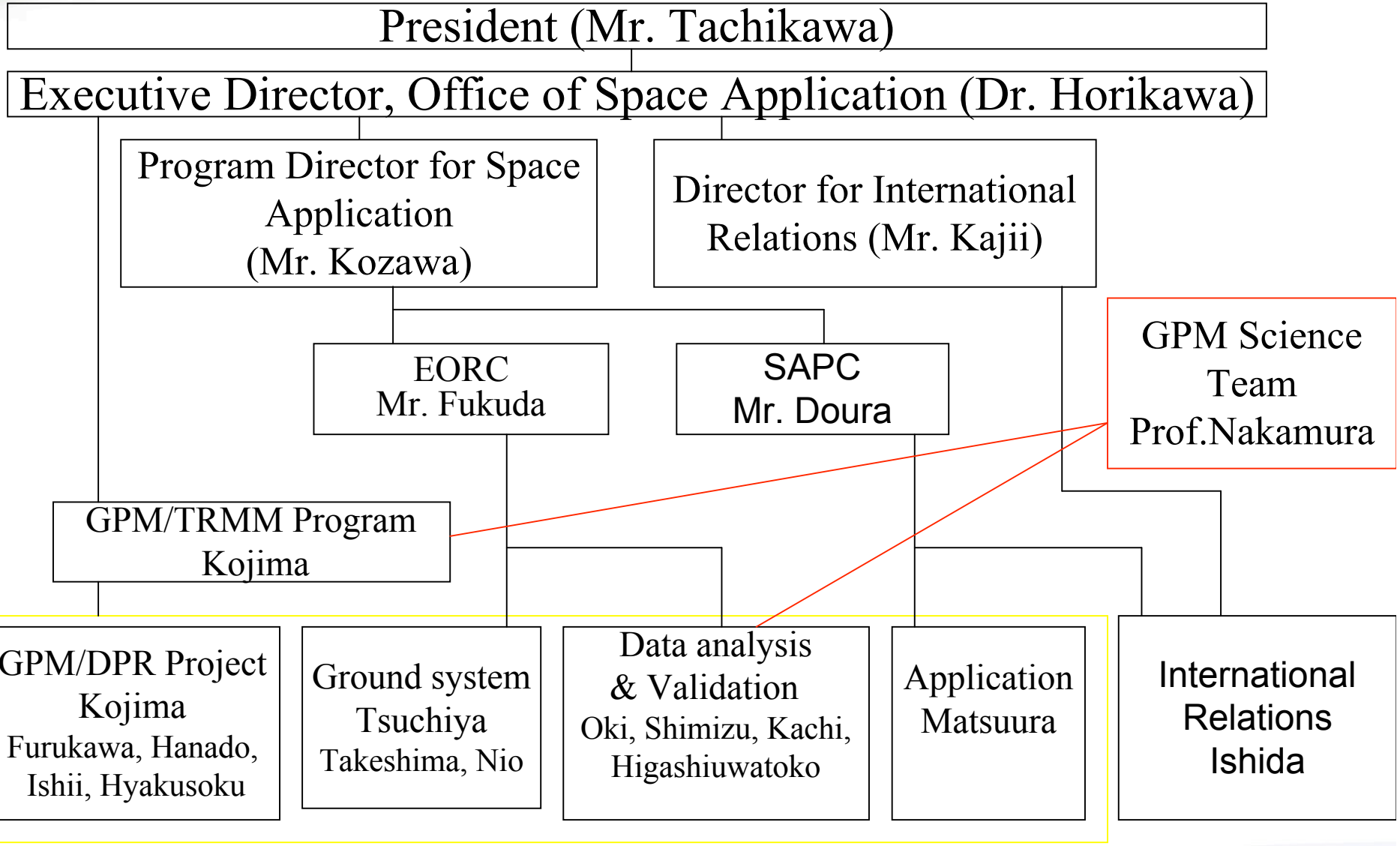
Progress and Status - Ground System, Science & Application -

- Ground System
  - ➢Conceptual Design continued
- Science & Application
  - ➢GPM/DPR science and application meeting was held in March, 2007 and 2008
    - ✓Revision of the mission success criteria and mission requirements
    - ✓Status of the algorithm development
    - ✓Status of the research and application activities
  - ➢Establishment of precipitation science team
    - ✓Precipitation mission science research RA for JFY 2007-2009
      - •13 PIs from Japan and 1 PI from a foreign country selected
    - ✓Research contract with 3 TRMM/PR standard algorithm PIs
    - ✓Research contract with 1 GPM research algorithm PI
    - → 18 PIs
  - ➢Science and application activity
    - ✓GPM algorithm development performed by Research Invitation (RI) and contracts
      - •DPR
      - •DPR-GMI combined
      - •Global precipitation map using MWRs and MW sounder data (GSMaP)
    - ✓Joint research with International Centre for Water Hazard and Risk Management (ICHARM)/ Public Works Research Institute (PWRI)
      - •Joint study continued
  - ➢CEOS precipitation constellation activity
    - ✓Jointly led by NASA & JAXA
    - ✓International Workshop held in June, 2007 in Washington D.C.
    - ✓Activity report prepared and submitted to CEOS in November

GPM/DPR Project Schedule

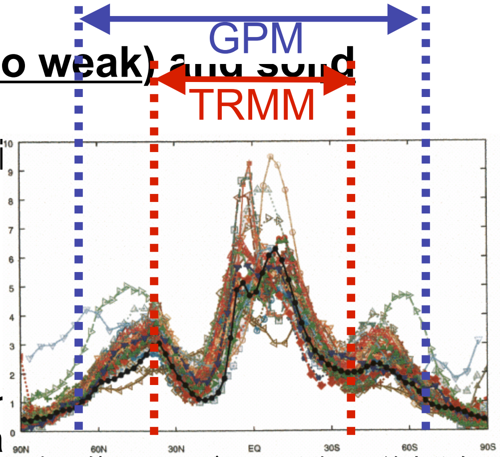


JAXA GPM/DPR Organization



Issues toward GPM

- **Precipitation observation in tropics to the globe**
  - **Accurate observation of liquid phase precipitation (<u>strong to weak</u>) and solid <u>phase</u> precipitation (snowfall･hailstone)**
  - **Improvement of MWR algorithms using DPR in mid-high lati
<u>land</u>**
  - → high sensitivity observation by GPM/DPR
- **Limitation of single frequency observation of PR**
  - **The difference between PR and TMI**
    - **Over ocean: 40% in Ver.4（1998.Oct）, 24% in Ver.5（1999.Novem
（2004.June）. Over land: bigger than 20%. Also depends on sea**
  - **User requirement is 10% error in monthly average. To realize this level of accuracy, dual frequency observation is necessary.**
  - → dual frequency (Ku and Ka) observation by GPM/DPR
- **Frequent observation**
  - **Frequent data is necessary for operational uses**
  - → utilization of MWRs and MW sounders in entire GPM mission
- **Long term precipitation observation**
  - **Radar and MWR observation from TRMM PR/TMI to GPM DPR/GMI**
- **Near real time data use**
  - **Need continuation of near real time data distribution for operational users such as NWF and flood warning systems**



観測値（黒）とモデルによる降雨の緯度分布
(Gates et al. (1999)による）

Primary scientific objectives may be:

Global change of precipitation through precipitation system climatology

Annual variation, etc.

Various precipitation processes

Algorithm

Pure space based algorithm via sound cloud physics

CRM, bin model, etc.

DPR algorithm

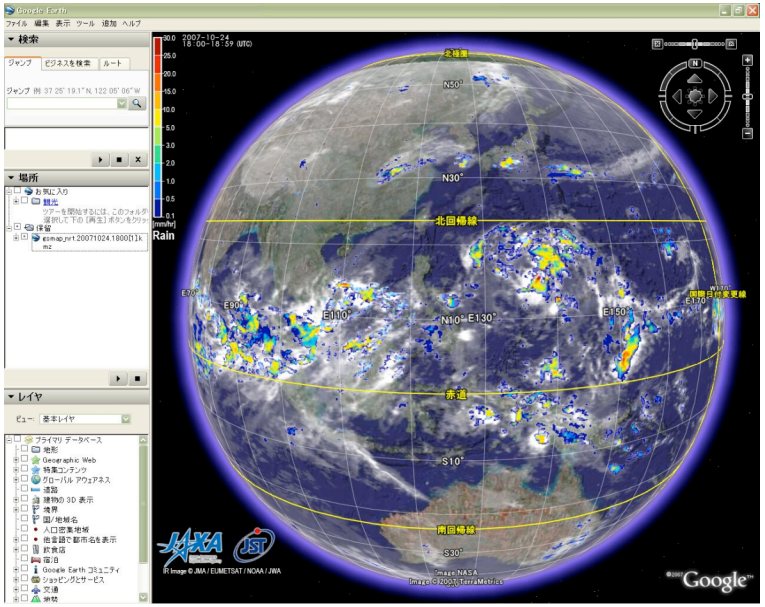
Global rain mapping

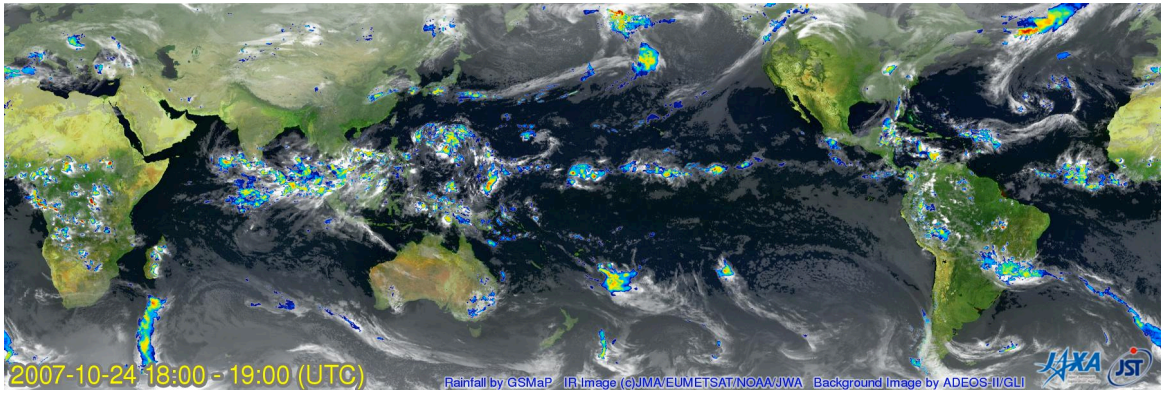
Applications

Weather forecast, hydrology, water resource management, flood warning

Near real-time high resolution global precipitation map product

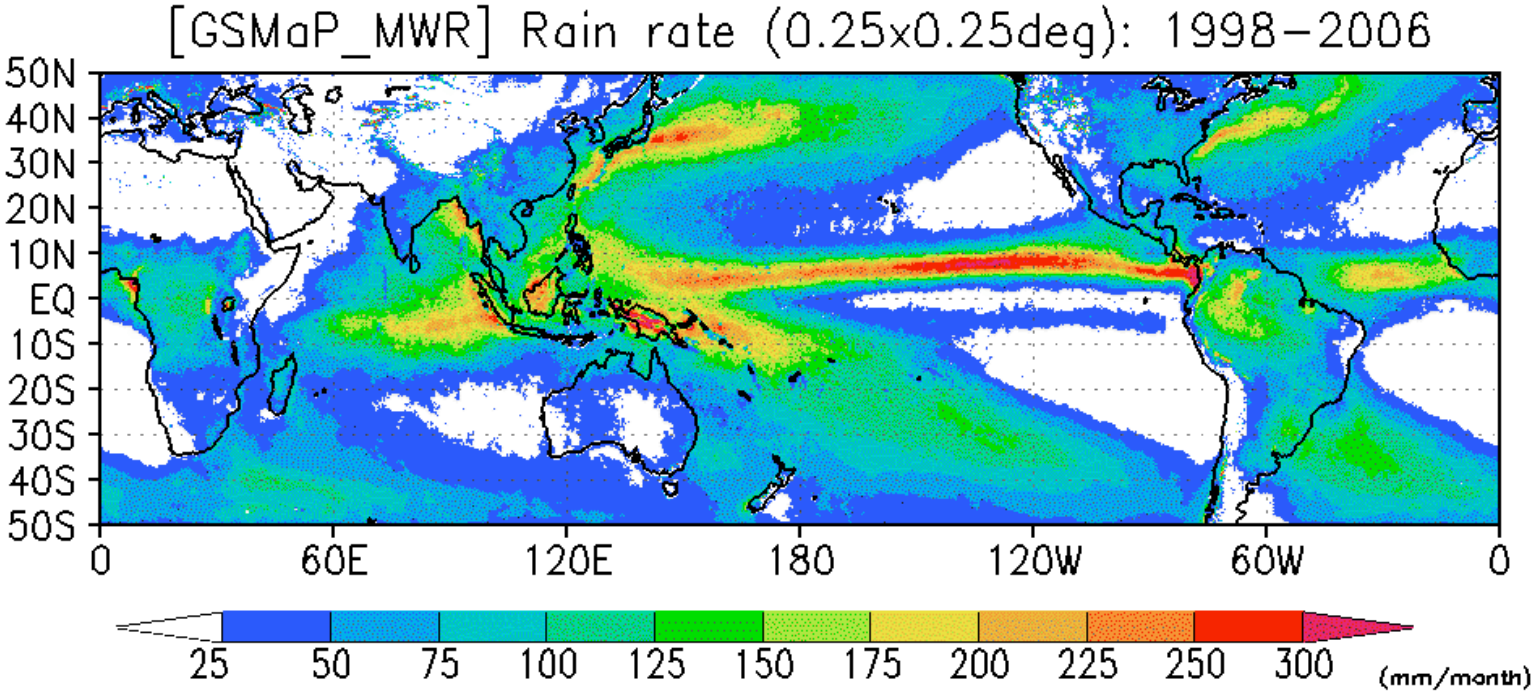
- Utilizing the results of the GSMaP(Global Satellite Mapping of Precipitation) project sponsored by the Japan Science and Technology Agency
- 0.1 degree grid, one hour averaged precipitation map
- Use Microwave Radiometer & sounder data such as AMSR-E, SSM/I, TRMM/TMI, AMSU-A/B
- Available on the web (http://sharaku.eorc.jaxa.jp/GSMaP/)





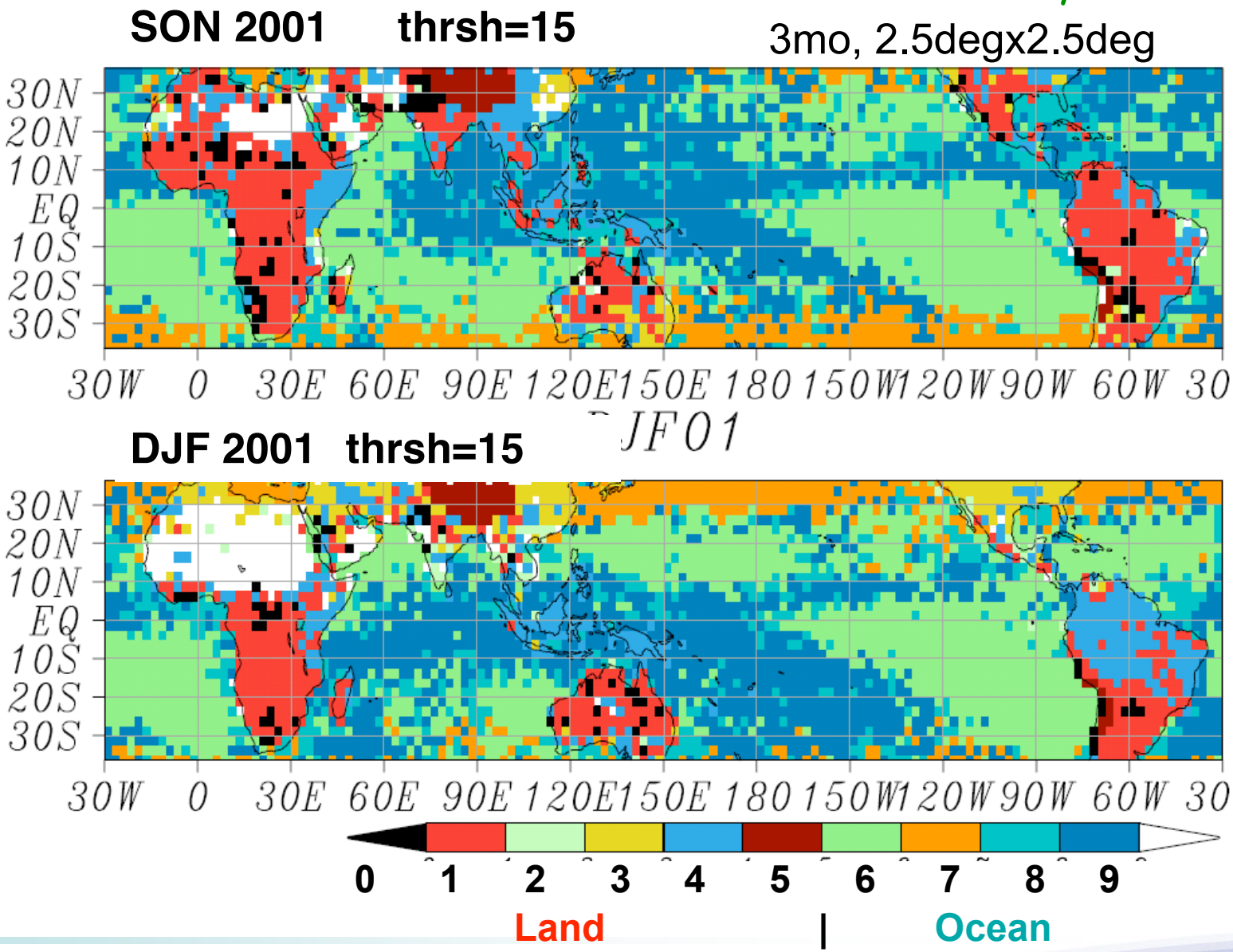
Cloud images provided by JMA, JWA, NOAA and EUMETSAT
Land image from GLI on ADEOS-II

1998～2006年平均値のGSMaP_MWR



Classification of Rain Systems

Takayabu and Katayama



(Land)

0: Severe Thunderstorm

1: Afternoon Shower

2: Shallow

3: Ext-trop Frontal System

4: Organized

5: High Land

(Ocean)

6: Shallow

7:Ext-trop Frontal System

8:Transition Z.

9: Organized

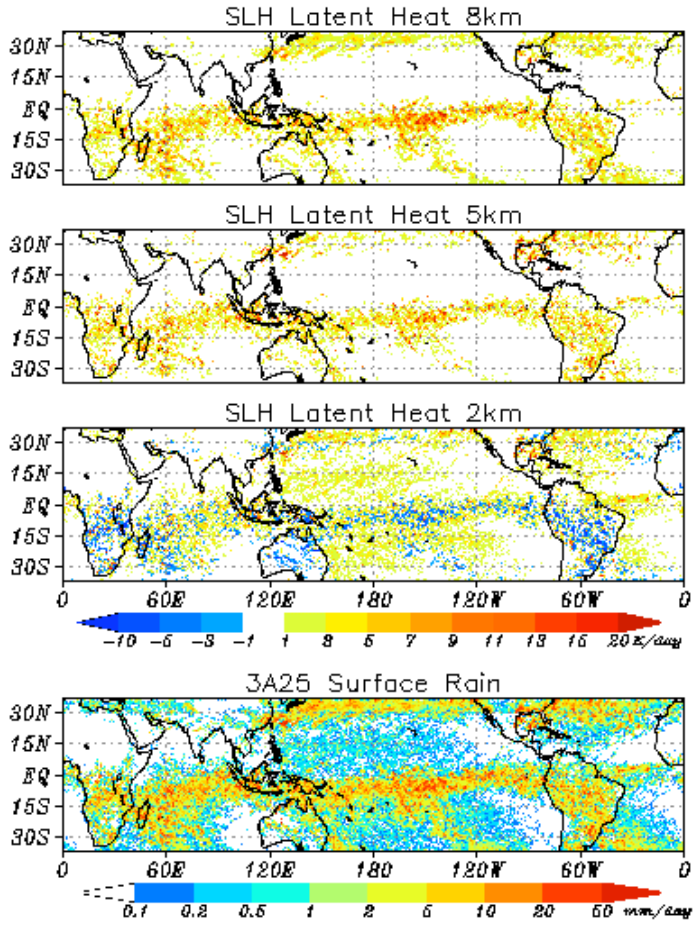
Estimations of latent heating profile

8km

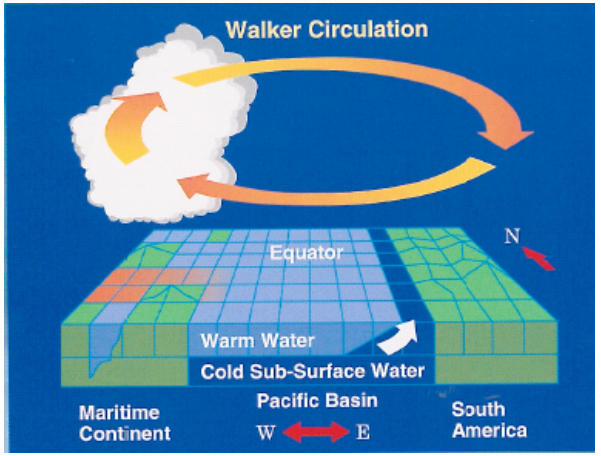
5km

2km

Monthly averaged surface rainfall



To estimate latent heat profile was listed up as one of the scientific goals of TRMM mission from the beginning.

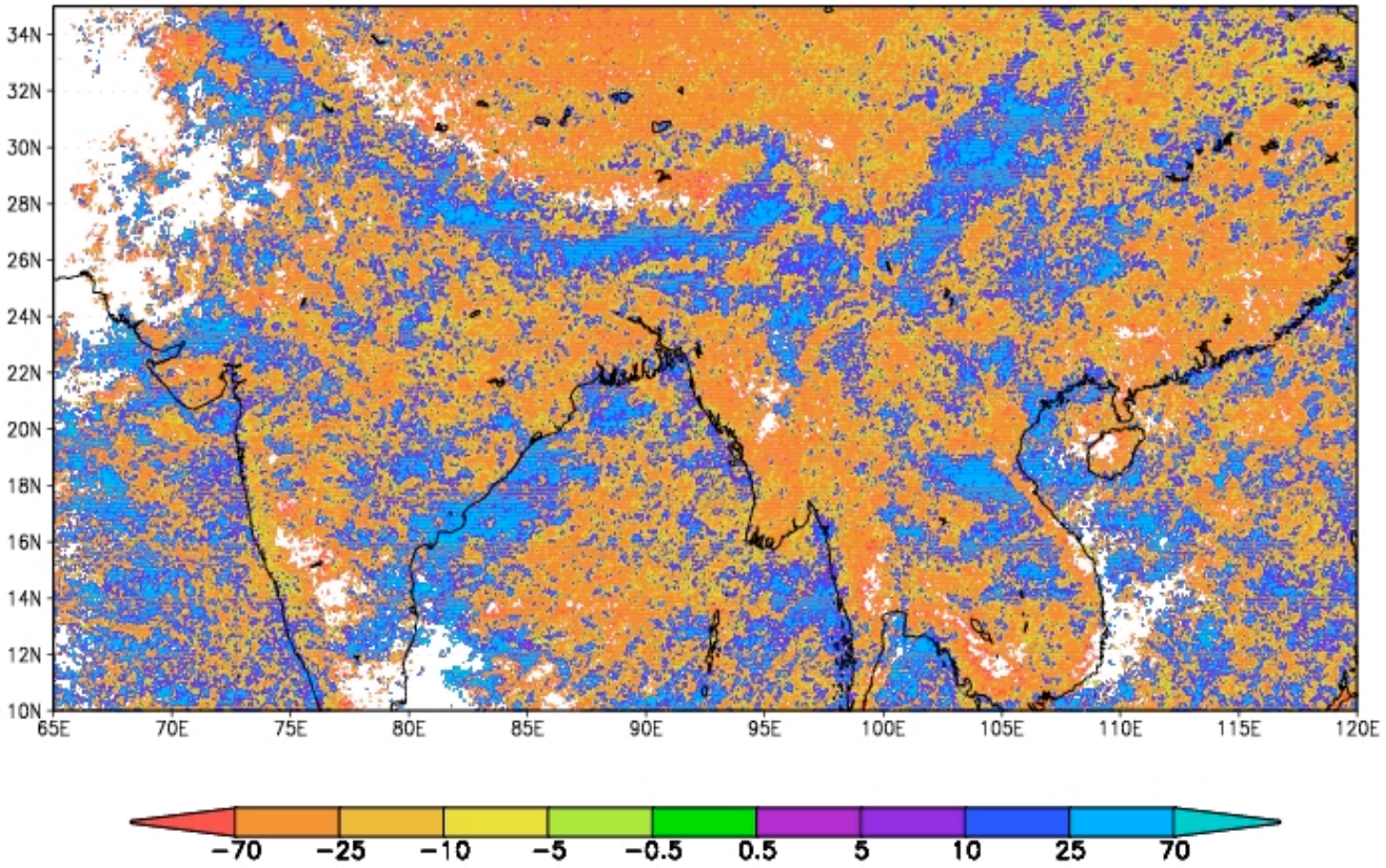


←relationship between tropical rainfall and general circulation（NASA）

(Left) Estimated latent heating ratio at different heights. Red: heating, Blue: cooling.
（Takayabu et al., University of Tokyo）

Atmospheric heating profile has been estimated by SLH algorithm using PR3D information. The data can be utilized for evaluation of global water & energy cycle and for improvement of climate models.

LT(1−6)−(12−18)


34N
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12N
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65E
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75E
80E
85E
90E
95E
100E
105E
110E
115E
120E
−70
−25
−10
−5
−0.5
0.5
5
10
25
70


tibet
Xizang (Tibet)
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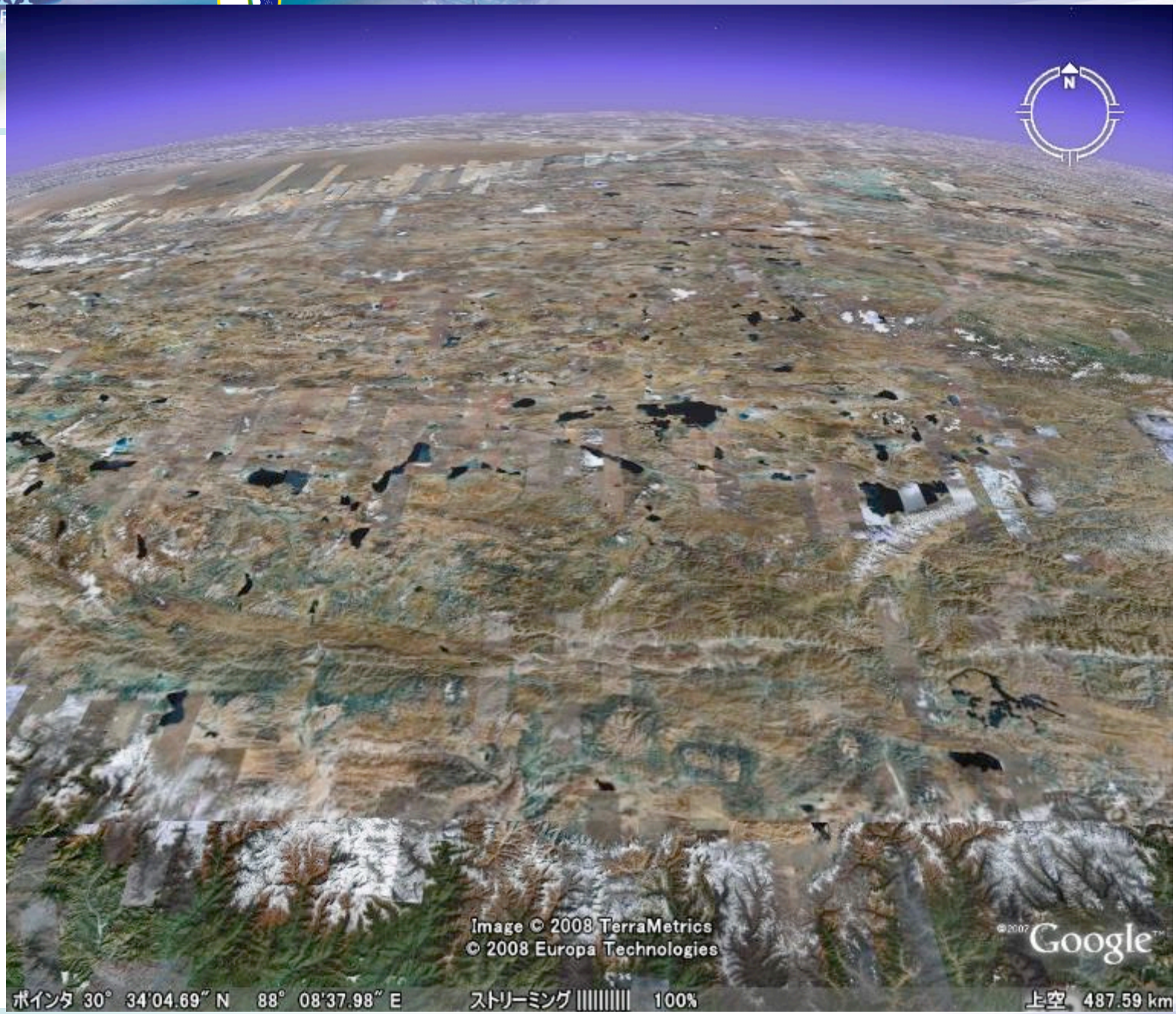
N
Image © 2008 TerraMetrics
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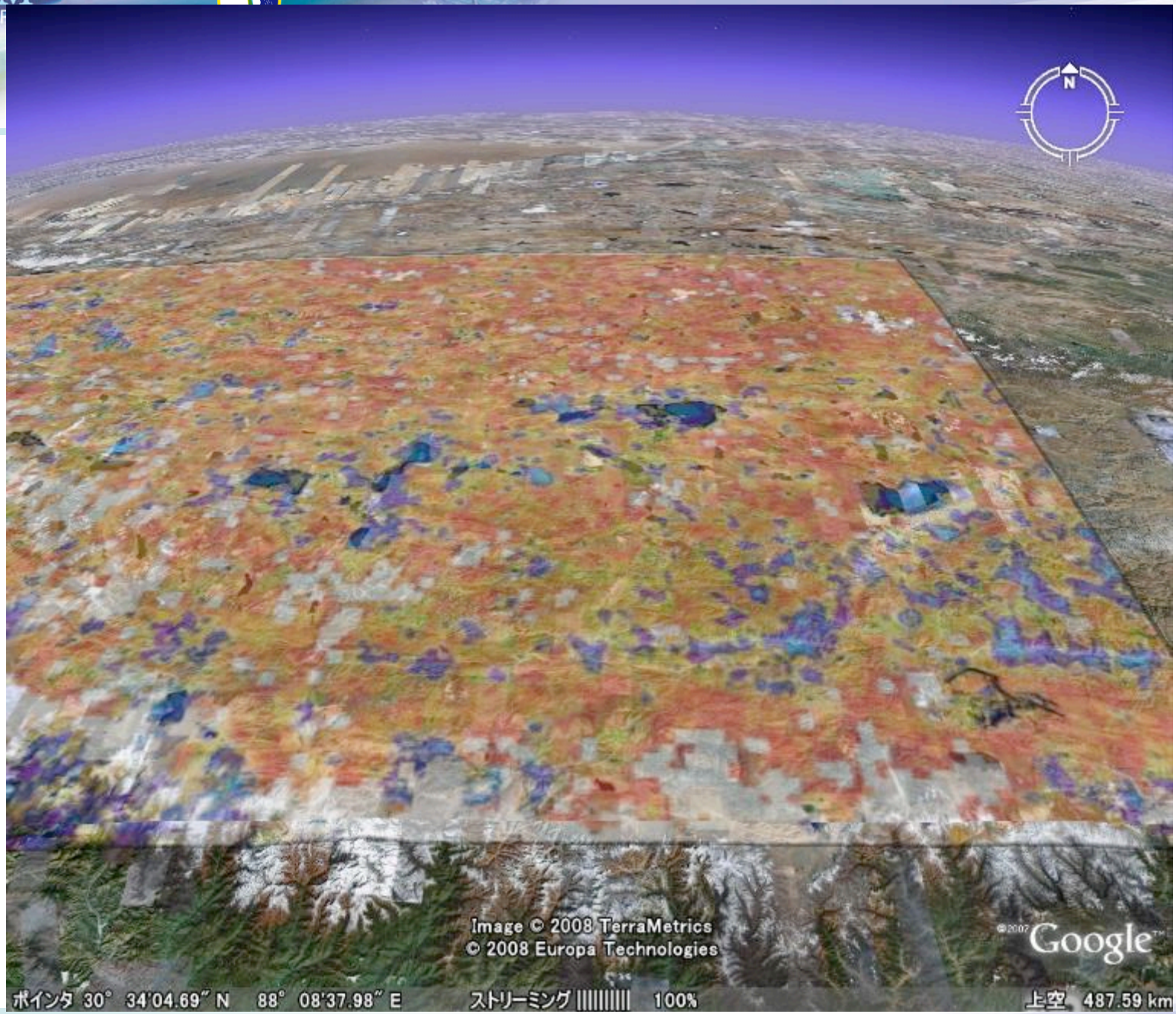
ポインタ 30° 34'04.69" N 88° 08'37.98" E
ストリーミング 100%
上空 487.59 km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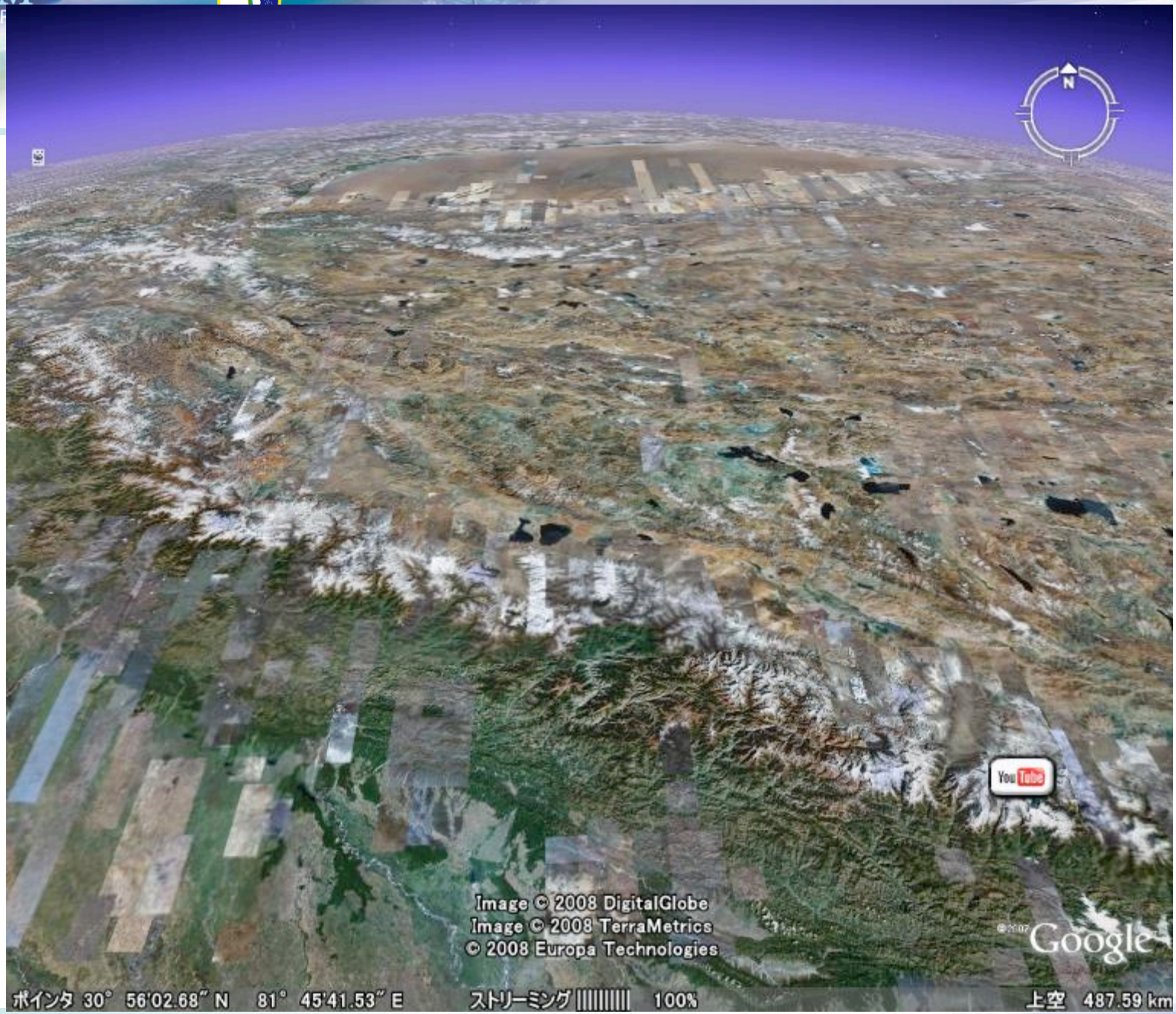
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ポインタ 30° 56'02.68" N 81° 45'41.53" E
ストリーミング 100%
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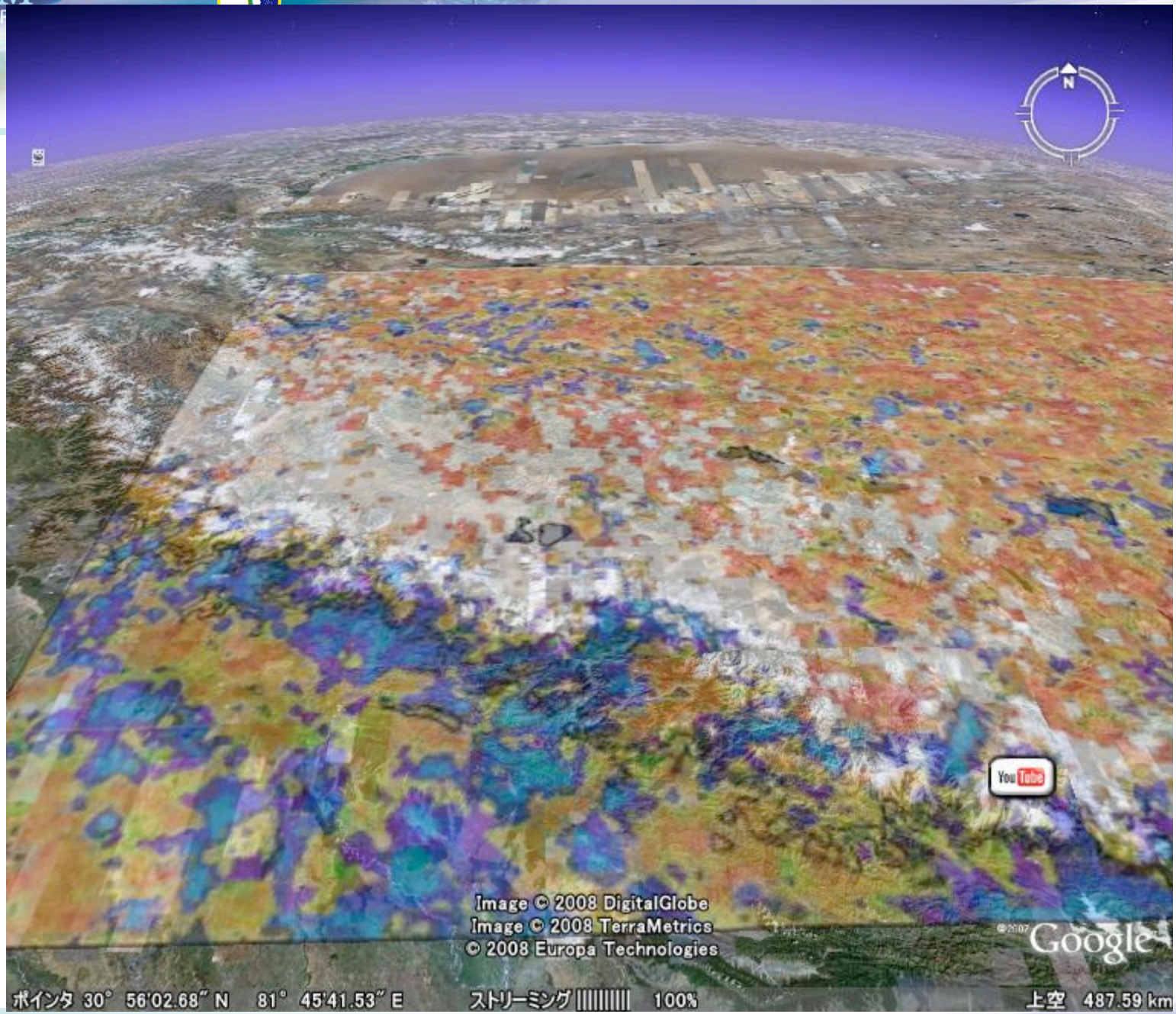
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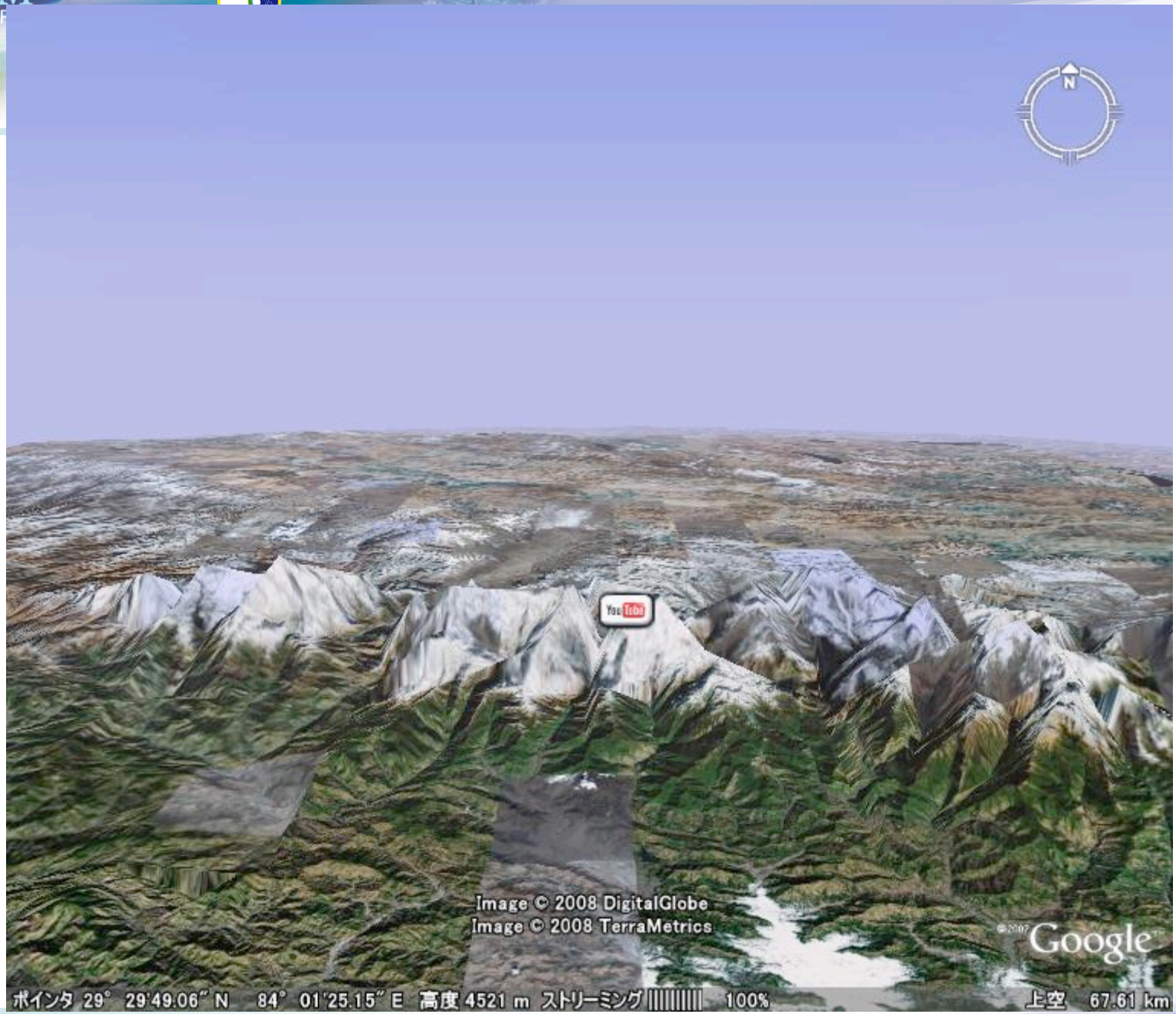
Image © 2008 DigitalGlobe
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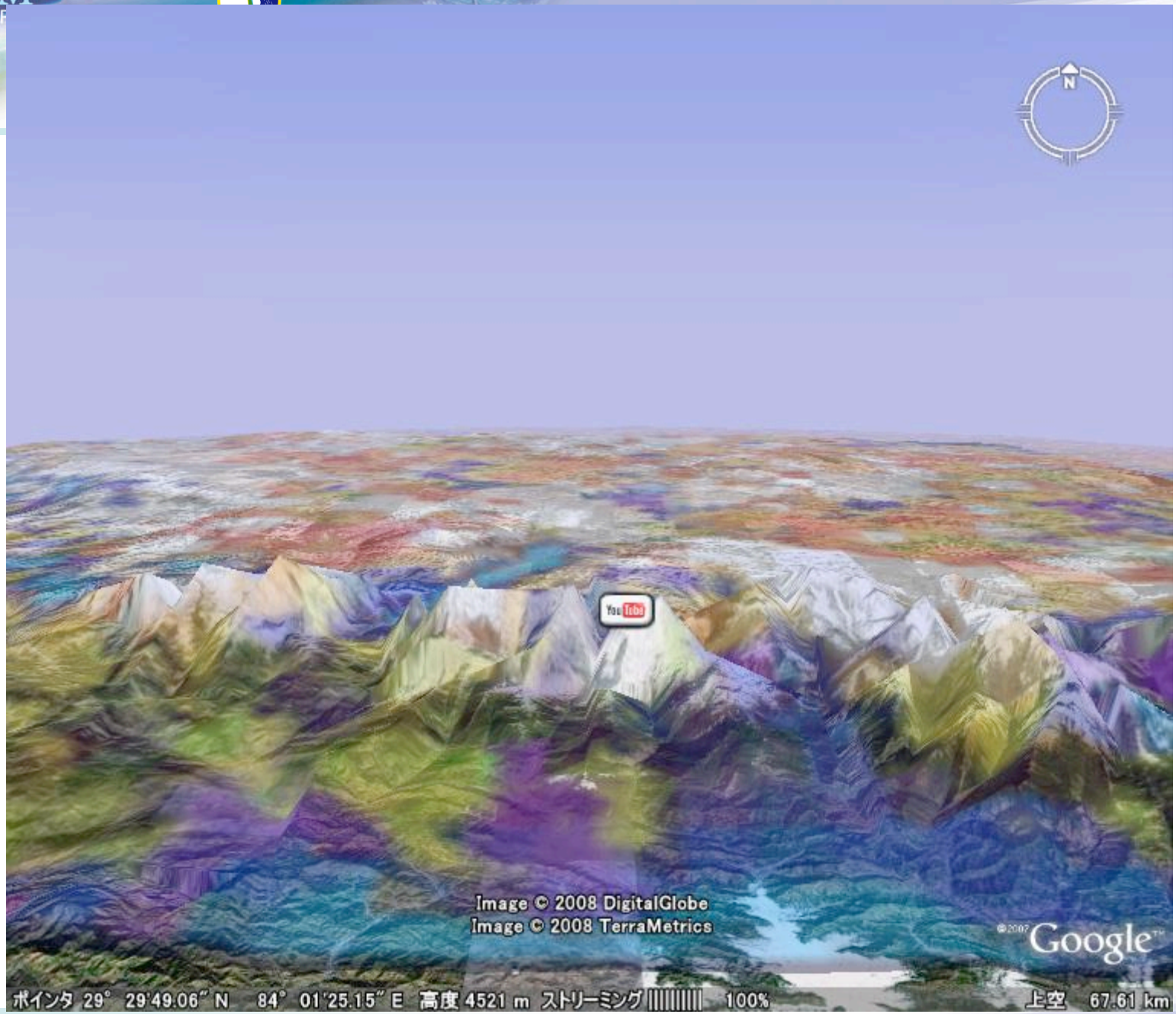
上空 67.61 km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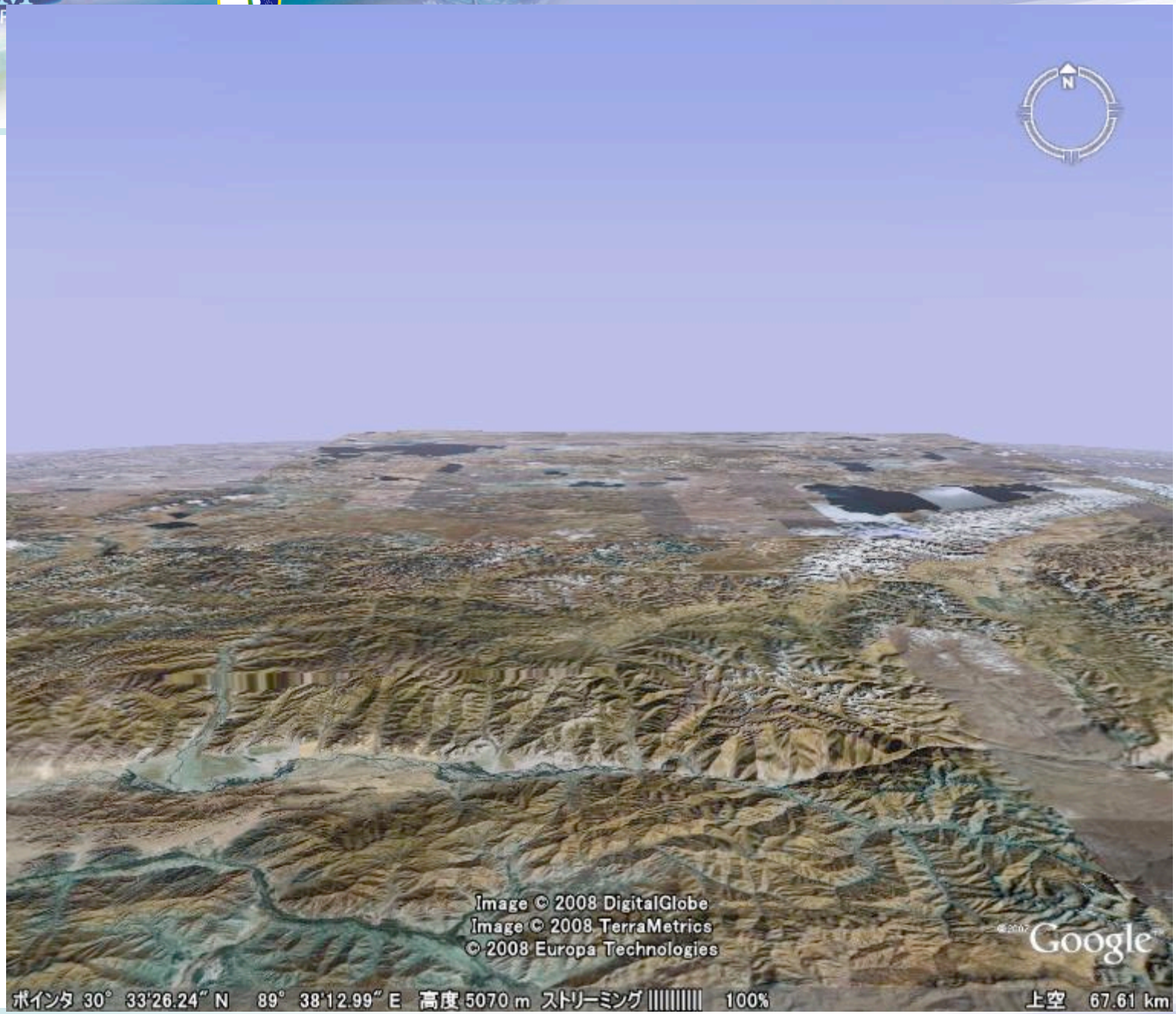
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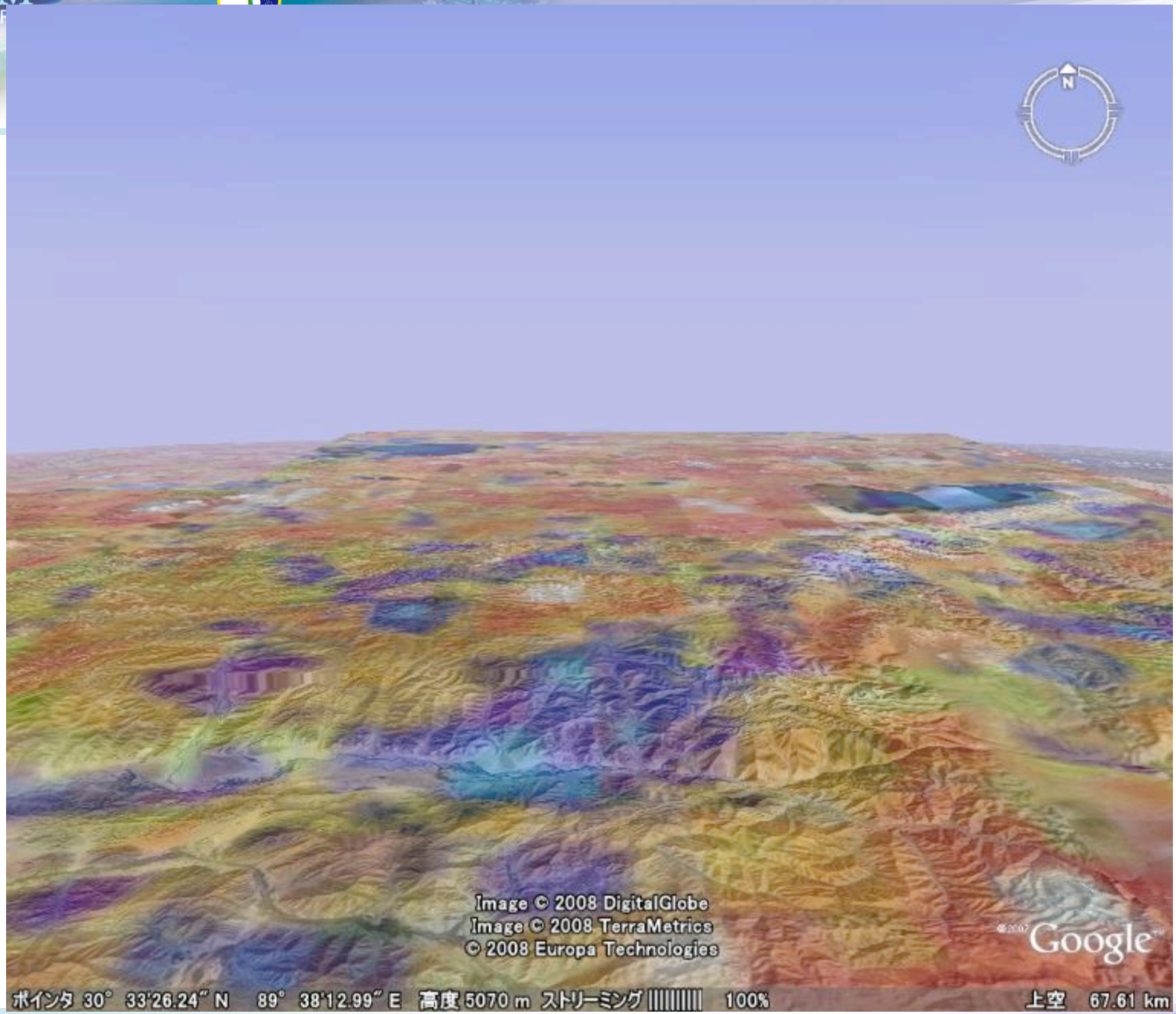
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上空 67.61 km

Backup